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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/505,179	08/31/2004	Norifumi Tokuda	257478US2PCT	8275
22850	7590	04/20/2006	EXAMINER	
OBLON, SPIVAK, MCCLELLAND, MAIER & NEUSTADT, P.C. 1940 DUKE STREET ALEXANDRIA, VA 22314			KUNZER, BRIAN	
			ART UNIT	PAPER NUMBER
			2814	

DATE MAILED: 04/20/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	Application No. 10/505,179	Applicant(s) TOKUDA ET AL.	
	Examiner Brian Kunzer	Art Unit 2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 13 February 2006.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 21-40 is/are pending in the application.
- 4a) Of the above claim(s) 31-38 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 21-30, 39 and 40 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \*    c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>8/31/04, 9/30/04</u> | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Election/Restriction*

1. Applicant's election with traverse of claims 21-30, 39, and 40 in the reply filed on March 30<sup>th</sup>, 2006 is acknowledged.

Applicant makes the following argument:

"Although the outstanding Official Action does not identify search classifications, it is believed that the claims of the present application would have to be searched in a handful of sub-classes. Furthermore, since electronic searching is commonly performed, a search may be made of a large number of or theoretically all, subclasses without substantial additional effort. Accordingly, Applicants respectfully traverse the Election Requirement on the grounds that a search and examination of the entire application would not place a serious burden on the Examiner, whereas it would be a serious burden on Applicants to prosecute and maintain separate applications."

Firstly, the outstanding Office Action, mailed January 13<sup>th</sup> 2006, *did clearly* identify and provide separate search classes for the identified distinct species. Secondly, Applicant is referred to MPEP 808.02, wherein one of the following must be shown for establishing serious burden:

- (A) Separate classification thereof : This shows that each invention has attained recognition in the art as a separate subject for inventive effort, and also a separate field of search. Patents need not be cited to show separate classification.
- (B) A separate status in the art when they are classifiable together : Even though they are classified together, each invention can be shown to have formed a separate subject for inventive effort when the examiner can show a recognition of separate inventive effort by inventors. Separate status in the art may be shown by citing patents which are evidence of such separate status, and also of a separate field of search.
- (C) A different field of search : Where it is necessary to search for one of the inventions in a manner that is not likely to result in finding art pertinent to the other invention(s) (e.g., searching different classes /subclasses or electronic resources, or employing different search queries, a different field of search is shown, even though the two are classified together. The indicated different field of search must in fact be pertinent to the type of subject matter covered by the claims. Patents need not be cited to show different fields of search.

Art Unit: 2814

Accordingly, since Examiner has exhibited the requirements of both (A) and (C), by providing different search classifications for each species, it is requested that Applicant withdraws the traverse of the Election Requirement.

***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 21-26 and 30 are rejected under 35 U.S.C. 102(b) as being anticipated by Terashima (USPN 5,289,019).

With respect to claim 21, Terashima teaches, from fig. 6, a semiconductor device comprising:

a first main electrode (8) provided on a first main surface of a semiconductor substrate (2); and

a second main electrode (9) provided on a second main surface of said semiconductor substrate (2), wherein a main current inherently flows in a thickness direction of said semiconductor substrate,

wherein said semiconductor substrate has at least one recess (41) formed in said second main surface and therefore said semiconductor substrate at least has a first region having a first thickness and a second region having a second thickness that is thinner than said first thickness, said second region corresponds to a region where said at least one recess is formed, said second main electrode (9) is provided in said at least one recess (41), and said second thickness is set at

Art Unit: 2814

such a thickness as to inherently keep a breakdown voltage of said semiconductor device. (See column 8.)

With respect to claim 22, Terashima teaches, from fig. 6, the semiconductor device wherein said second main electrode (9) is formed of a material that inherently makes ohmic contact (the electrode is in direct contact with a highly conductive region, 12) or Schottky contact with said semiconductor substrate (2). (See column 8.)

With respect to claim 23, Terashima teaches, from fig. 6, the semiconductor device further comprising a semiconductor region (11 or 12) provided in a surface of said semiconductor substrate (2) in a portion corresponding to a bottom of said at least one recess (41), said semiconductor region (11 or 12) having a higher impurity concentration than said semiconductor substrate (2). (See column 8.)

With respect to claim 24, Terashima teaches, from fig. 6, the semiconductor device wherein said semiconductor region (11) has a conductivity type opposite to that of said semiconductor substrate (2). (See column 8.)

With respect to claim 25, Terashima teaches, from fig. 6, the semiconductor device wherein said semiconductor region (12) has a same conductivity type as said semiconductor substrate (2). (See column 8.)

Art Unit: 2814

With respect to claim 26, Terashima teaches, from fig. 6, the semiconductor device wherein said recess (41) is located substantially in a center of said semiconductor device.

With respect to claim 30, Terashima teaches, from fig. 6, the semiconductor device wherein a side of said at least one recess (41) is inclined at an angle exceeding 90° with respect to said second main surface.

Claim 40 is rejected under 35 U.S.C. 102(b) as being anticipated by Tsukuda (USPN 6,054,748).

With respect to claim 40, Tsukuda teaches, from fig. 35, a semiconductor device comprising:

a first main electrode provided (9) on a first main surface of a semiconductor substrate;  
and

a second main electrode (8) provided on a second main surface of said semiconductor substrate, wherein a main current inherently flows in a thickness direction of said semiconductor substrate,

wherein said semiconductor substrate has at least one recess (under 14) formed in said second main surface and therefore said semiconductor substrate at least has a first region having a first thickness and a second region having a second thickness that is thinner than said first thickness,

and wherein said second thickness is inherently set at such a thickness as to keep a breakdown voltage of said semiconductor device,

Art Unit: 2814

said second region corresponds to a region where said at least one recess (under 14) is formed,

said at least one recess (under 14) is filled with a conductor layer (8 in recess), and

said second main electrode (8) is provided on a surface of said conductor layer (8 in recess).

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over Terashima (USPN 5,289,019) as applied to claim 21 above, and further in view of Kitada (USPN 6,404,032).

Terashima teaches the semiconductor device as stated above.

Terashima does not specifically teach that the semiconductor device further comprises an insulating film provided in a surface of said semiconductor substrate in a portion corresponding to a side of said at least one recess.

However, Kitada, drawn to semiconductor device with a Schottky junction, teaches, from fig. 7, an insulating film (16) provided in a surface of a semiconductor substrate (2) in a portion corresponding to a side of at least one recess (4). (Also see column 7, lines 24-33.)

Art Unit: 2814

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to have the device of Terashima include an insulating layer on the recess sidewalls as disclosed by Kitada in order to reduce the effects of current leakage. (See column 7, lines 24-33.)

4. Claims 28 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Terashima (USPN 5,289,019) as applied to claim 21 above, and further in view of Sakamoto (USPN 5,841,181).

With respect to claim 28, Terashima teaches the semiconductor device as stated above.

Terashima does not specifically teach the semiconductor device further comprising a field contact ring.

However Sakamoto, drawn to semiconductor devices with field limiting rings, teaches from figs. 1-5, a field contact ring (4a, 4b) (a.k.a. field limiting ring) provided in a first main surface of a semiconductor substrate (1a-1c), for alleviating an electric field in a peripheral portion of the semiconductor device, wherein a second region (device region) is provided in an area surrounded by said field contact ring (4a, 4b). (See abstract.)

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to have the device of Terashima including the field limiting rings of Sakamoto in the first region thereby eliminating electric field discontinuity and increasing the breakdown voltage. (See abstract and fig. 2.)

With respect to claim 29, Terashima, combined with Sakamoto (from figs. 1-5), teach the semiconductor device wherein said field contact ring (4a, 4b) is provided in the first main surface



Art Unit: 2814

of the semiconductor substrate (1a-c) in a portion corresponding to the first region (i.e. on the periphery of the device).

Claim 39 is rejected under 35 U.S.C. 103(a) as being unpatentable over Terashima (USPN 5,289,019) as applied to claim 21 above.

Terashima discloses the claimed invention except for specifically teaching the first thickness is set in the range of 500 to 650 $\mu$ m. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use this claimed range, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 105 USPQ 233. In addition, Terashima discloses the claimed invention except for specifically teaching the second thickness is set at around 60  $\mu$ m. It would have been obvious to one having ordinary skill in the art at the time of the invention was made to arrive at this claimed value, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

### ***Conclusion***

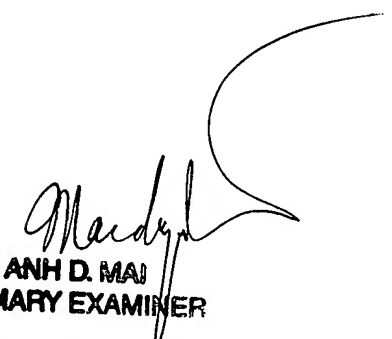
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian Kunzer whose telephone number is (571) 272-5054. The examiner can normally be reached on Monday-Friday 8:00-4:30 EST.

Art Unit: 2814

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

BK  
4/11/2006



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PRIMARY EXAMINER